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Micro-Photography

52

Dessalet '04.

"MICRO-PHOTOGRAPHY."

Edwin C. Dessalet

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The object of this thesis is to investigate the method of Micro Photography and also to show how the physical structure of steel changes with the change in the percentage carbon present.

The subject is one which is still in its early stage of development and references upon it are scarce. I obtained a good many practical ideas from Dr. Amos P. Brown. Professor of Geology and Mineralogy in the University of Kansas and from Albert Butler, '01 class of 1901.

The thesis is divided into four parts, first we will deal with the description of the apparatus and the way in which it is used

Part III will describe the way in which a specimen is prepared for photographing.

Part IV will describe the way in which the apparatus is arranged for taking a photograph and the taking of the photograph.

Part V will contain the points to be from the negatives taken from specimens which I have prepared and also the date of the specimen.

Cont'd

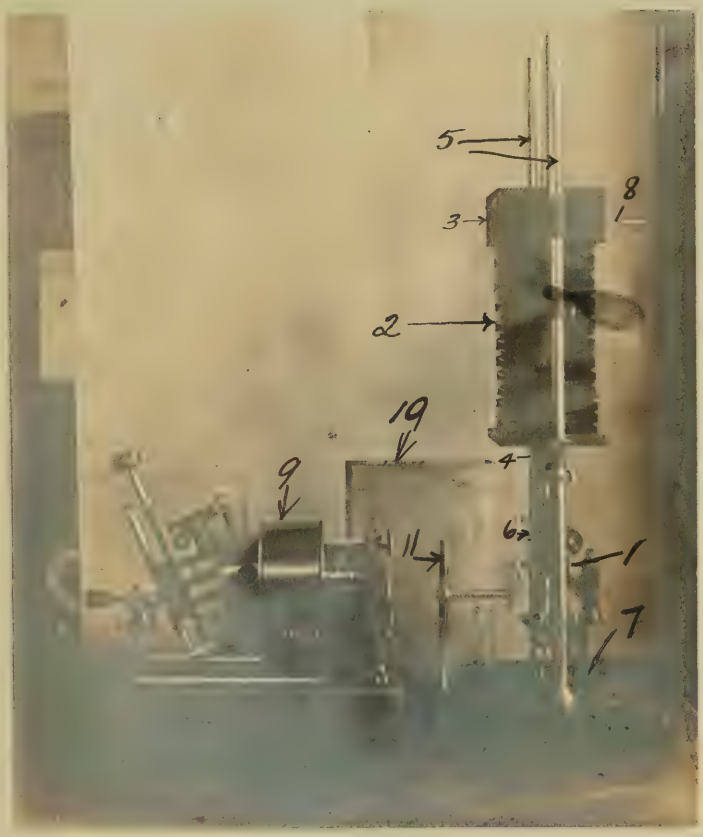

PLATE I. APPARATUS.

The apparatus used for this Thesis is shown in the above print. Consisting of a increaser (1), a bicalorimeter, descriptive of which can be found in appendix II.

The camera (2) consists of an ordinary bellows, having a plate holder receiver at the top (3) with a ground glass field. There is no lense in the front end (4), but a hole $\frac{3}{4}$" in diameter and a shade sleeve which fits over the eye piece of the microscope. The camera is mounted on two vertical rods (5) which are fastened to a cast iron base (6). The back vertical rod is jointed at (7) to allow the camera to be swung about the other rod and allow an ocular observation to be taken. (8) the front end of the Camera is a rod (8) which forms a support when the apparatus is used in a horizontal position.

The source of light for illuminating

the specimen is the arc lamp (1).
A suxiliary hand feed arc lamp such as is used in Stereoptican Work. The Rheostadt (10) is used in connection with the lamp. It has three terminals for allowing the lamp to be used on 110 volt and 50 volt circuits.

The sub-condensing lense (11) is mounted in such a way as to allow the lense to be placed in any position by means of a ball and socket joint and an extension arm.

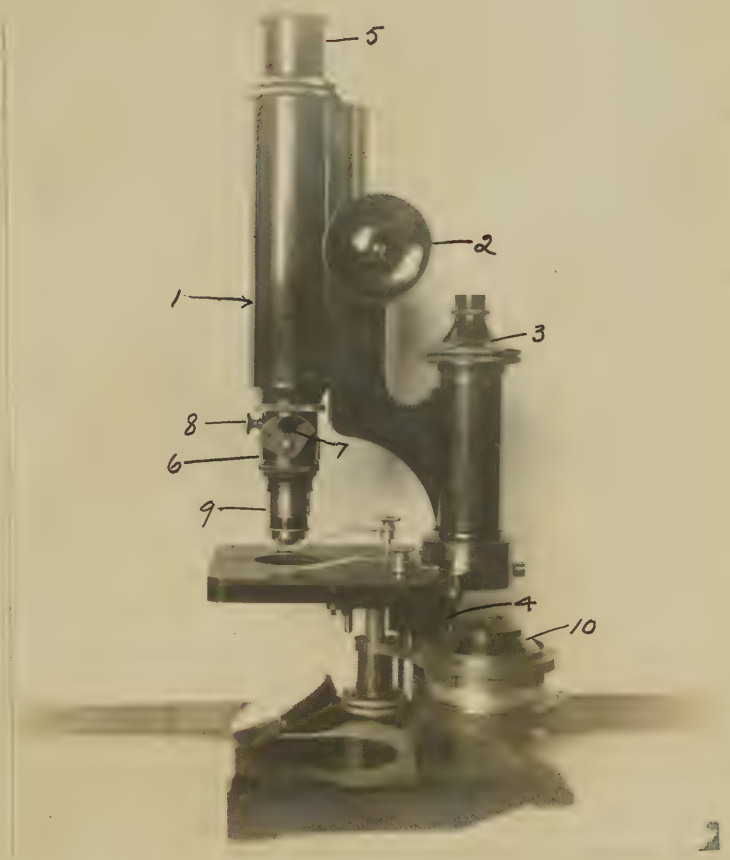

PLATE II MICROSCOPE.

The barrel (1) is moved up and down for focusing by the fast motion screw (2) and a slow adjustment screw (3). The upper part of the microscope is hinged at (4) to allow

the instrument to be used in a horizontal position, when the camera is being used in a horizontal position.

The eye-piece (5) is movable in the barrel, which changes the magnification or medium, having a higher degree when pulled out.

The vertical illuminator (6) consists of a short cylindrical tube having a hole (7) in the side. A circular piece of glass is mounted to turn on an axis, perpendicular to the axis of the tube and opposite the centre of the hole (7) in the tube. This piece of glass forms a mirror so the inside of the brass tube is blackened and a ray of light entering the hole 7 will be reflected

down, when the mirror is turned by the button (8) into the perpendicular and illuminates an object placed below the objective upon the stage of the microscope.

Three objectives are supplied with the microscope and the one used is attached to the end of the vertical illuminator at (9). With these three objectives and the two eye pieces, a wide range of magnifications can be obtained. The extension of the bellows of the camera increases the magnification of the whole apparatus.

The sub-condensing lens (10) is used together with the mirror in cases where transmitted light is used, as in transparent slides

work. The sub-condenser (10) can be made either on a fixed platform, as it is mounted on a vertical direction by a screw. The separation is adjusted for a certain magnification, in a manner that will be described later, and the specimen placed in view on a flatt piece of wood set upon the top of the condensing device. Then by turning the screw, for adjusting the incidence the surface of the specimen can be brought into the focus of the microscope without changing the legal magnification.

The polishing wheels four in number are mounted on one horizontal axis. They are shown together with the motor that drives

Shown in plate (3). The first wheel is a fine emery wheel. The second wheel is an iron wheel covered with canvas duck. The third wheel is a pith wheel one made of wood and covered with a fine cloth called doe. The specimen when polished is held against the side of the wheel, being held in a small screw vice.

PART TWO.

PREPARATION OF SPECIMENS.

The specimen is cut from a suitable piece of metal and is filed as nearly cubical as possible making the sides from $\frac{3}{8}$" to $\frac{1}{2}$" in length. Care should be taken in having the faces parallel so that the polished surface will be parallel to the stage of the microscope and hence perpendicular to the axis of the microscope. They are handled more easily in polishing when the sides are parallel.

The surface that is to be polished is beveled with a file on its edges and corners so that there is no sharp points left that would catch in the covering of the wheels and rip the covering to pieces.

The specimen is then held in a

over clamp and the surface to be polished is ground on the fine emery wheel until it is flat and free from any fissures or marks left from the filing.

The wheel covered with the canvas duck is wet with water and a paste of emery powder from wheel and water is applied with a rag. This wheel removes all the sharp scratches made by the emery wheel and leaves a surface having very fine scratches. Hardly any pressure is exerted when holding the specimen against these covered wheels.

The wheel covered with doe nearest the canvas covered wheel is then wet with water and a

paste of tripoli powder white in color with water is applied with a rag. The specimen when polished with this wheel and powder should be free from all scratches and have a polish on the surface.

The final polishing is done on the wheel lining the box covering on the inside. This is rubbed with water and a paste of pumice stone powder Red oxide with water is applied with a rag. This wheel and powder will produce a very fine polish on the surface of the specimen.

In polishing on the covered wheels the wheels should always be rubbed with water and never allowed to become dry.

After the specimen has been has been polished, it must be etched in order to bring out the structure of the surface. A good solution for etching is a 10% solution of nitric acid in alcohol. The surface and part of the specimen to be etched is immersed in this solution and held there for about 15 seconds then the surface is held up and watched and as soon as it becomes dark it is washed in alcohol.

The surface, when viewed through a microscope shows up the hard crystalline parts formed of iron and carbon called "Ferrite" and the dark part around these is the slag or iron. In some specimens the ferrite parts form a regular network

PART III

TAKING THE PHOTOGRAPH

The apparatus should be set up in a dark room as possible so as to cut out all the sources of light.

The diagram in plate 4 shows the best way in which the apparatus should be arranged to obtain a uniform illuminated field.

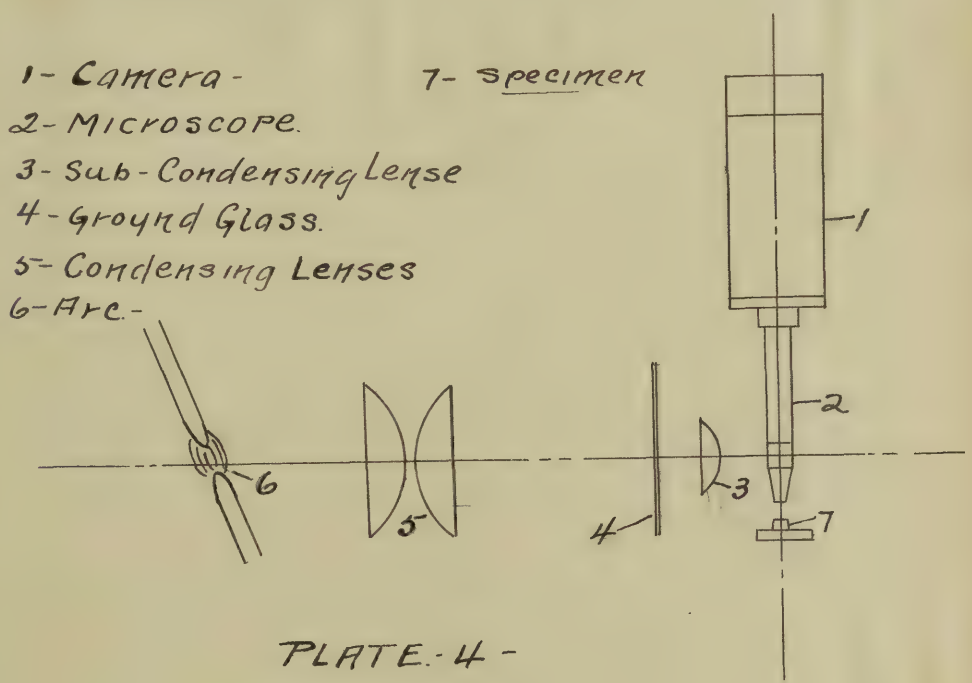

PLATE.-4-

The ground glass (4) is placed in the

path of the light in order to remove
an image of the positive carbon from
the field. This would produce an
unexposed spot of light on the plate.
(I have placed a shown in the diagram
a stop which uniformly illuminated
a circle formed on the glass about two
inches in diameter. The sub-condenser
lens then collects the light and
condenses them into the microscope.

The time of exposure depends upon
a number of things. The intensity of
the light at the surface, the degree of
magnification, the nature of the surface
the degree to which the surface is polished
and the speed of the plate which is used.

I found that with slow plates the
detail showed up a great deal better than
with fast plates. When I took my first

Untouched using the ground glass I take an exposure of seven seconds for cabinets & associates. For any cash pictures using the ground glass I give an exposure of 10 seconds.

I used Carbutt's Metric-Hydro under favorable conditions the plate and prints will [illegible] ordinary sodium exposure & is a fine plate.

The degree of magnification is obtained by reflecting light through a glass scale placed on the stage of the microscope and then placing a steel scale on the ground glass of the camera. The brass mounted glass scale which I used has two scales one is the inch system and the other is the centimeter system. The inch system scale has two tenths of an inch divided into

hundredths and between the ten tenths is a hundredth of an inch divided into thousandths. The centimeter scale is two millimeters divided into tenths and between the ten millimeters is a tenth of a millimeter divided into hundredths of a millimeter.

I used a magnification of fifty 50 diameters, so that the hundredths of an inch space on the glass scale equaled a half of an inch on the ground glass in the top of the camera.

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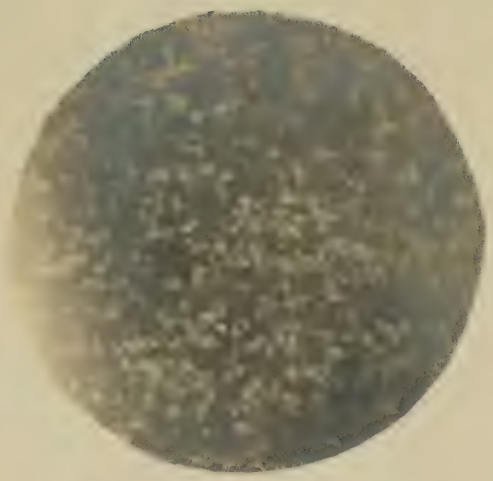
PART IV.

RESULTS.

The prints following are made from negatives taken of Specimens of Bessemer Steel - supplied by the Cambria Steel Company.

The prints #18 and #19 are made from negatives of Alloys of Brass and Babbit Metal given to me by the Chemical Laboratory with their chemical analysis.

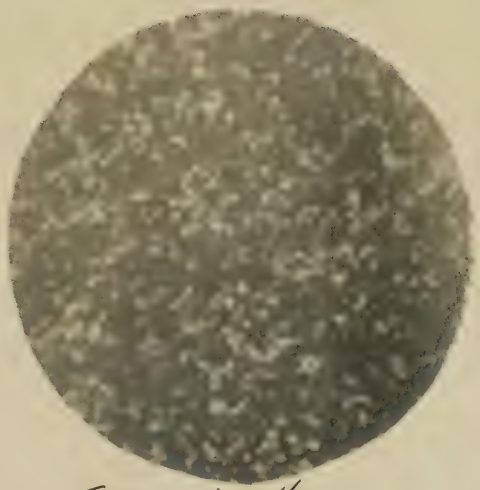


SPECIMEN #1
BESSEMER STEEL #763215
CARBON .1%

SPECIMEN #2
BESSEMER STEEL #763176
CARBON .11%

SPECIMEN #3
BESSEMER STEEL #736185
CARBON .12%

SPECIMEN #4
BESSEMER STEEL #763536
CARBON .13%



SPECIMEN #5
BESSEMER STEEL #763189
CARBON .16%

SPECIMEN #6
BESSEMER STEEL #763375
CARBON .22%

SPECIMEN #7
BESSEMER STEEL #763190
CARBON .25%

SPECIMEN #8
BESSEMER STEEL #763353
CARBON .3%

SPECIMEN #9
BESSEMER STEEL #763350
CARBON .32%

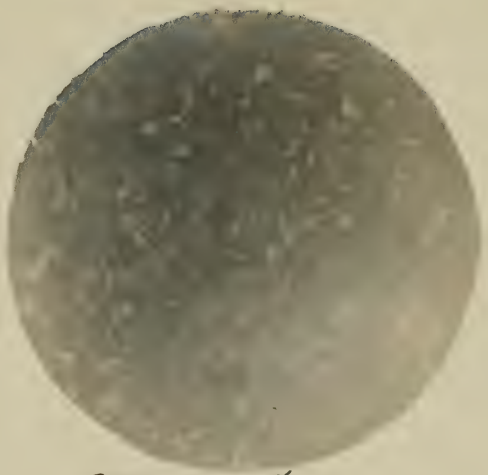
SPECIMEN #10
BESSEMER STEEL # 763399
CARBON .38

SPECIMEN #11
BESSEMER STEEL #763404
CARBON .46%

SPECIMEN #12
BESSEMER STEEL #763381

SPECIMEN #13
BESSEMER STEEL #763324
CARBON .5%

SPECIMEN #14
BESSEMER STEEL #763415
CARBON .63%



SPECIMEN #15
BESSEMER STEEL #763428
CARBON .65%

SPECIMEN #16
BESSEMER STEEL #763152
CARBON .73 %

SPECIMEN #17
BESSEMER STEEL #62147
CARBON .74

In looking through the specimens no special changes can be detected in consecutive prints in the amount of Ferrite, but in looking at prints of the extreme percentages of carbon you can easily detect the changes in the structure.

SPECIMEN #18
BRONZE ALLOY - COPPER-TIN-LEAD.

SPECIMEN #19
BABBIT METAL - LEAD - 59.56%
TIN - 40.43%

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N/1198/03070/5425X

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